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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The Modular Automatic Test Equipment (MATE) program currently does not address
networking of Automatic Test Equipment (ATE). This paper discusses the economic
advantages of networking and some factors that should be considered when establishing
a network.

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Report MAG 88-003-01

Networking of ATE

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15 April 88

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Report ID: MAG 88-003-01

Title: Networking ATE

Author(s): _Donald B McComb_ Date: _15 Apr 88_

_____ Date: _____

_____ Date: _____

Standing
Committee
Chairperson: _O. T. Smith Jr._ Date: _15 Apr 88_

Executive
Committee
Chairperson: _Larry K. Israel_ Date: _21 Nov. 88_

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Preface

This report was written by members of the MATE Applications Group (MAG) to assist the Modular Automatic Test Epuipment (MATE) program.

MATE is an Acquisition Management program established by AFSC/AFLC regulation 800-23.

The MAG was established in recognition of the need for Air Force users to influence the application and future of MATE. This need was identified during the AFLC MATE Conference held at Wright Patterson AFB on 31 March 1987.

The overall objective of the MAG is to support and improve the MATE concept and programs. This will be accomplished by assessing the needs of the maintenance community and establishing a means of communicating those needs from the operating/user (maintenance) organizations to the managing/acquisition organizations.

This report must be considered in the context of the MATE program.

Acknowledgments

I would like to acknowledge the help of:

Don Morely
SA-ALC/MATTS
Kelly AFB, Tx 78241

O.T. Smith
WR-ALC/MAITA
Robins AFB, Ga 31098

1 ISSUE

MATE currently does not address the networking of testers. Yet, networking in the depot environment significantly increases productivity.

2 FACTORS BEARING ON THE ISSUE

2.1 Facts.

a. In the depot environment most testers support a large number of TPSs. This requires either:

    1) Large disc units.

    2) Loading TPSs from other media at run time.

b. Current MATE implementations use either cartridge or 9-track magnetic tapes to load TPS data to the tester.

c. Loading from tape particularly the cartridge takes significant amounts of time (3 to 6 minutes for a 9 track 7 to 12 minutes for a cartridge).

d. TPS development requires multiple work sessions on off-line support equipment and testers. As the TPS progresses through the development cycle it is executed on the tester. Problems are identified while on the tester. The TPS is then revised on the off-line equipment. It then is cycled back to the test station for more testing. This cycle is repeated multiple times (20-30) depending on the complexity of the TPS. As the software will be slightly different for each cycle, it has to be loaded to the tester each time.

e. Typical depot sites include multiple copies of testers, disc storage space for all TPSs on each tester is an equipment duplication we can not afford, thus the TPS must be loaded each time it is executed.

f. There are many good networks commercially available.

2.2 Assumption.

We want the most efficient and cost effective operation possible, both during TPS development and production testing of end items.

2.3 Criteria.

a. Any network should provide bridges to networks currently in use at the depot.

b. Any network should be cost effective.

c. Any network should be supportable.

3 DISCUSSION

3.1 TPS Development

Currently in the MATE environment it takes a significant amount of time to get from the off-line support computers to the testers. A typical scenario goes like this:

1) Developer decides its time to go to the tester. He leaves his desk gets a tape and heads for the VAX.

2) Once at the VAX he must, find a free tape drive, mount the tape, find a free terminal, log onto the VAX, command the VAX to make the tape, dismounts the drive, logs off the VAX, and removes the tape off the drive.

3) Once at the MATE tester he must log on, load the tape on the drive, download the tape, take the tape off the drive and start the test. (This scenario assumes he is lucky enough to have a nine-track drive on the MATE tester.)

4) If at the end of the test he wants to take data back to the VAX he must reverse the process.

If the VAX and the MATE tester were networked the scenario would be:

1) Developer decides its time to go to the tester. He leaves his desk and heads for the tester.

2) Logs on the tester and downloads the program from the VAX. Starts test.

3.2 Production

Production could be enhanced also. Currently unless large disk drives were purchased, they must load programs from tape. This runs into some of the same delays as associated with TPS development.

If there was a fast network available a file server could be used, this would reduce the setup time required. In fact if a file server was employed disk-less testers could be used.

Disk-less testers would have several advantages:

1) Smaller size

2) Higher reliability

3) Better configuration Control

3.3 Savings

3.3.1 TPS Development

TPS:

As on average a TPS will cycle between a tester and development station thirty times. If twenty minutes can be saved each time, that equates to 10 man hours ($400) saved for each TPS.

Tester:

If you figure that 10 minutes of tester time may be saved each time you load a program, and you are putting 6 programs a day on the tester that's 1 hour a day of tester time saved. This could make the difference of having to buy 8 instead of 9 testers for a program. A possible savings between $700,000 and 1.5 million dollars.

3.3.2 Production of End Items

If ten minutes were saved each time a program is loaded if 6 different programs are loaded a day that would save a hour a day. That would result in:

1) A Labor savings of $40 a day (About $8,000 a year).

2) A 12% reduction in station loading. This could result in fewer testers being required.

Note: Above figures based on the tape cartridge on the DATSA, lower figures would result if a faster tape unit was used. But even if 50% of the savings were realized it would be significant when taken over several years of operation.
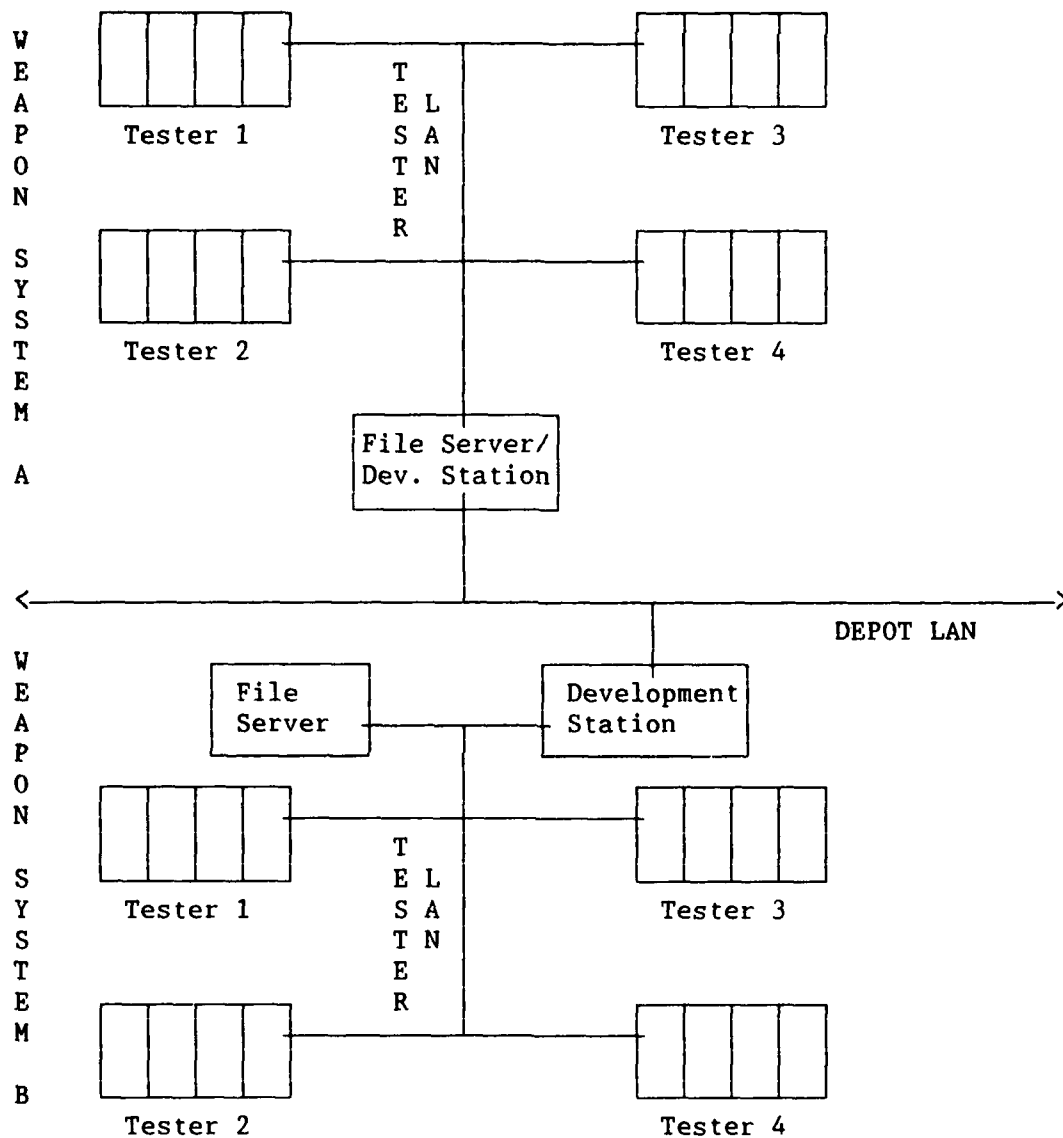
3.4 Costs

The biggest cost of networking is the connecting of the computer hardware to the LAN. However, connection costs are coming down. For commercial computers they are running typically from $300 to $3,000. This would be the cost range for MATE stations running commercial computers and operating systems.

The first implementation on a 1750A computer would require changes to MOS. We are unable to give a firm estimate of this one time cost. We expect the cost would be between $100,000 and $200,000.

3.5 Local Area Networks (LANs)

The diagram on the next page shows a typical set up as envisioned for depot applications. Several testers will be tied together on a Tester LAN along with a computer(s) serving as a file server, development station and bridge. This Tester LAN will be tied to a Depot LAN. In turn the Depot LAN will be connected to other Tester LANs.

```
W    ┌─┬─┬─┬─┐                        ┌─┬─┬─┬─┐
E    │ │ │ │ │────────┐    ┌─────────│ │ │ │ │
A    └─┴─┴─┴─┘     T  │    │          └─┴─┴─┴─┘
P     Tester 1    E L │    │           Tester 3
O                 S A │    │
N                 T N │    │
      ┌─┬─┬─┬─┐   E   │    │          ┌─┬─┬─┬─┐
S     │ │ │ │ │───R───┘    └──────────│ │ │ │ │
Y     └─┴─┴─┴─┘                        └─┴─┴─┴─┘
S      Tester 2                         Tester 4
T
E              ┌──────────────┐
M              │ File Server/ │
               │ Dev. Station │
A              └──────────────┘

   <───────────────────────────────────────────────>
                                        DEPOT LAN
W              ┌──────────┐    ┌──────────────┐
E              │ File     │    │ Development  │
A              │ Server   │────│ Station      │
P              └──────────┘    └──────────────┘
O    ┌─┬─┬─┬─┐                        ┌─┬─┬─┬─┐
N    │ │ │ │ │────────┐    ┌─────────│ │ │ │ │
      └─┴─┴─┴─┘    T  │    │          └─┴─┴─┴─┘
S     Tester 1    E L │    │           Tester 3
Y                 S A │    │
S                 T N │    │
T                 E   │    │
E     ┌─┬─┬─┬─┐   R   │    │          ┌─┬─┬─┬─┐
M     │ │ │ │ │───────┘    └──────────│ │ │ │ │
      └─┴─┴─┴─┘                        └─┴─┴─┴─┘
B      Tester 2                         Tester 4
```

LAN EXAMPLE

The two tester LANS and the Depot LAN could all be of different types. For example, the Depot LAN could be a DECnet Ethernet, one tester LAN could be a token bus and the other tester LAN could be a third type.

The key to networking are the bridges. With them it is possible to chose the best LAN available for the job. And not be constrained to using a LAN just because there is one like it in place already.

There are many LANs currently available, and the technology is progressing rapidly. Bridging allows you to take advantage of the latest developments.

4

Some things to look at when choosing a LAN are:

    1) Any network used should provide a smooth interface between the testers and the file server or off line development system.

    2) It should meet the performance required for that application. Several things need to be considered on performance:

        a. What size of pipe (That is what is the maximum amount of data it is possible to shove down the cable. Usually measured in Millions of Bits a Second.) is required?

        b. How fast can the boards interfacing the computers and testers handle data. For instance a 10 Mbit/sec pipe does you no good if your computer can only output the data out at 250kbit/sec.

        c. What type protocol is being used. For file transfers a token based protocol is faster than a Collision-Detect protocol for the same size pipe.

    3) How far apart are the testers going to be? Some LANs are very restrictive as far as distance.

    4) Does it have an established user base? This is an important indicator of its maturity.

    5) Is it based on one of the IEEE 802 standards? This increases the chance of multiple vendors.

    6) Does it support the Open System Interconnection (OSI) protocols? The OSI standards are evolving, a network that supports the OSI shows that it is growing in a controlled manner.

    7) Do bridges exist for networks you might wish to connect to? In the examples show above the Development Stations acted as bridges to other LANs. And do the bridges provide a smooth interface?

4   CONCLUSIONS

    1) Networking would definitely be cost effective for testers.

    2) There is no reason to standardize on any particular LAN, as long as proper consideration is taken during the selection process.

5   ACTIONS RECOMMENDED

1) Add to the MATE guides, the recommendation that testers be networked. (A GIF has been submitted).

2) Add to the MATE guides the methodology on how to select the right LAN.

3) Adapt the MATE Control Support Software to support networking (A SEF has been submitted).

DoD GUIDE IMPROVEMENT FORM		
DATE 13 Apr 88	**REF NO.**	**LOG NO.**

GUIDE REFFERENCE: WRITE APPROPRIATE NUMBERS FOR GUIDE,VOLUME,PART, SECTION AND PARAGRAPH(S) IN BLANKS

PRIMARY IMPACT: G___ V___ S___ PARAGRAPH(S)_____ GUIDE ISSUE_____

OTHER IMPACTED GUIDES: ___New Work_____

PROBLEM:

       Each MATE tester is now configured as a stand alone unit. Significant savings could be ·ealized if testers targeted for depot use were networked (See attached report).

SUGGESTED IMPROVEMENT:

      See attached report.

(IF MORE SPACE REQUIRED,ATTACH ADDITIONAL SHEETS)

NATURE OF SUGGESTION:

  CATAGORY: _x_ MGMT _x_ ENG HDWR _x_ ENG SOFTWR ___LOGISTICS ___OTHER

  TYPE: ___EDITORIAL ___CORRECT DEFICIENCY _x_ NEW WORK
  EFFORT: ___MAJOR _x_ MEDIUM ___MINOR

ORIGINATOR:
   Donald B. McComb
	PHONE NO.
	   AV 468-5061

ORGANIZATION ADDRESS:
    WR-ALC/MAITC   ROBINS AFB GA 31098

FORWARD TO: SA-ALC/MMT
                 MATE SYSTEM GUIDE MANAGER
                 KELLY AFB TX 78241-5000

APPENDIX B

MATE

SOFTWARE ENHANCEMENT FORM

1. SYSTEM/PROJECT NAME
   None
	2. DATE PREPARED
	   13 Apr 88
		3. SE #

4. TITLE OF SE Networking of Depot Testers		
5. ORIGINATOR Don McComb WR-ALC/MAITC Robins AFB Ga 31098	6. COMPONET AFFECTED MOS	
7. DESCRIPTION OF NEED FOR SE Each MATE tester is now configured as a stand alone unit. Significant savings could be realized if testers targeted for depot use were networked (See attached report). MOS may have to be modified to handle networking.		
8. DESCRIPTION OF RECOMMENDED SE Enhance MOS to handle networking.		
9. ALTERNATIVES TBD		

10. BASELINE PRODUCT AFFECTED
    TBD
	11. DOCUMENTATION AFFECTED
	    TBD	

12. AFFECT ON SYSTEM RESOURCES(e.g.,PROCESSING TIME,MEMORY SPACE etc.) TBD		
13. DEVELOPMENTAL REQUIREMENTS TBD		
14. DATE NEEDED BY TBD		
15. COST SCHEDULE OR INTERFACE IMPACTED?		
16. GOVERMENTS ACTION		
17. DATE OF PROPOSED IMPLEMEMTATION.		
AUTHORIZING SIGNATURE	TITLE	DATE